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Initial and persistent changes in cancer screening in a US Midwestern community health center network following the onset of COVID-19

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ABSTRACT

Objective: To assess longer-term change in breast, cervical, and colorectal cancer screening among Community Health Centers (CHCs) following onset of COVID-19.

Methods: Among 27 CHCs in the US Midwest, we examine trends in standard electronic clinical quality measures and test-volume based cancer screening measures from January 2019 through October 2021. Test-volume measures include the number of cancer screening tests completed, the difference between the actual versus expected cumulative number of tests completed (i.e. pandemic screening gap), and the recent testing ratio (i.e. proportion of individuals up-to-date on screening who completed testing in the past year).

Results: Standard cancer screening quality measures showed only modest changes. In contrast, test-volume measures show large and persistent deficits. After a sharp drop in screening activity in early 2020, activity resumed but failed to reach pre-pandemic levels. As a result, the pandemic screening gap continued to grow larger over time reaching approximately 5400 fewer breast, 8600 fewer cervical, and 4500 fewer colorectal cancer screenings performed. This represents a 16–18 % deficit in the number of tests and is the equivalent of 3.5–4.0 months of dedicated pre-pandemic cancer screening activity. The recent testing ratio also decreased in 2020 and also failed to return to pre-pandemic levels.

Conclusions: Following onset of COVID-19, there was a persistent negative change in cancer screening in our CHC network. This change is more evident when examining test-volume compared to standard quality metrics. Understanding and addressing the persistent pandemic cancer screening gap is critical to limit health burdens and disparities related to cancer.

1. Introduction

Following the start of the COVID-19 pandemic, many studies reported decreases in the number of cancer screenings and cancer diagnoses and a shift toward more advanced stage at diagnosis (Walker et al., 2021; Carroll et al., 2022; Luu, 2022; Holland et al., 2022; Kelkar et al., 2022; Lee et al., 2022; Mazidimoradi et al., 2022; Chen et al., 2021; Li et al., 2023; Ng and Hamilton, 2022; Mazidimoradi et al., 2021; Ishibashi et al., 2022; Cano-Valderrama et al., 2023). Modeling predicts that pandemic-related delays in cancer screening will lead to thousands of excess cancer deaths (van den Puttelaar et al., 2023; Alagoz et al., 2021; Cancino et al., 2020). One recent study reported an increase in cancer deaths in the US from 2019 to 2021 (Concepcion et al., 2023).

While the initial negative changes in cancer screening following COVID-19 are recognized, less attention has been paid to potential longer-term changes. Addressing the potential pandemic impact on cancer screening means at a minimum 1) resumption of cancer screening services and 2) catching up on the number of missed screenings both at an individual and also at an organizational level (Holland et al., 2022).

Community Health Centers (CHC) provide health care to individuals

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who often have a lower socioeconomic status and live in communities that experience greater health inequities (Adashi et al., 2010). The COVID-19 pandemic caused substantial disruptions in delivery of cancer screening services at CHCs. Over half of CHCs participating in a national cancer screening quality initiative reported a complete interruption of cancer screening activities early in the pandemic (Fisher-Borne et al., 2021).

Given concern that pandemic could widen disparities in cancer burden, it is critical to understand both the initial and any persistent effects of the pandemic on delivery of cancer screening services, particularly for organizations that serve groups that already bear a higher cancer burden. To address these questions, we examined trends in breast, cervical, and colorectal cancer screening from 2019 through 2021 in a statewide CHC network. We examine both standard quality metrics and test volume-based metrics (i.e. change in number of cancer screening test performed) to provide a more complete picture of the impact of the pandemic on delivery of cancer screening services.

2. Methods

2.1. Setting

This study describes the delivery of cancer screening services in the Michigan Primary Care Association (MPCA) from 2019 to 2021. MPCA includes 40 CHCs that serve a diverse population of over 700,000 individuals across the state. This time period includes the year prior to and 18 months following the first reported cases of COVID-19 in Michigan (i.e. March 2020).

2.2. Data sources

Data for this analysis comes from a central data repository maintained by MPCA using the Azara platform. Azara is a third-party data integration platform that aggregates data from electronic medical record systems. We limit this analysis to data from 27 health centers that had established and maintained a connection with the MPCA central data repository over this entire time period.

3. Metrics

3.1. Standard quality metrics

We report standard quality metrics for breast, cervical, and colorectal cancer screening created by the National Committee for Quality Assurance based on United States Preventive Services Task Force recommendations and measured by standardized electronic clinical quality measures (eCQMs) (eCQI Resource Center, 2024). Each measure is expressed as a proportion of eligible patients who are adherent with cancer screening recommendations. Individuals are excluded from this calculation based on relevant general (e.g. in hospice care) or condition specific (e.g. prior bilateral mastectomy, hysterectomy with no residual cervix, total colectomy) health history. The standard breast cancer screening metric (CMS125v10) represents the percentage of women age 50–74 years who had a mammogram in the 27 months prior to the end of the measurements period (eCQI Resource Center: Breast Cancer Screening, 2024). The standard cervical cancer screening metric (CMS124v10) represents the percentage of women age 21–64 years who had either cervical cytology in the last 3 years (for women age 21–64) or cervical human papilloma virus testing in the last 5 years (for women age 30–64) (eCQI Resource Center: Cervical Cancer Screening, 2024). The standard colorectal cancer (CRC) screening metric (CMS130v10) during our study time period represents the percentage of adults age 50–75 years who had appropriate screening (based on screening method within a given timeframe) for CRC (eCQI Resource Center: Colorectal Cancer Screening, 2025). These measures are typically reported by CHCs as part of the National Health Center Program Uniform Data System (National Health Center Program Uniform Data System (UDS), 2024). We report annual eCQM metrics from 2019 to 2021.

3.2. Test volume metrics

Cancer screening test volume metrics we report are largely consistent with those reported by Miller et al. (Miller et al., 2021) Specific metrics include:

1. The absolute number of cancer screening tests completed each month including a breakdown of CRC screening by screening method (e.g. fecal immunochemical test (FIT), FIT-DNA stool test, and colonoscopy).
2. The actual versus expected cumulative number of cancer screening tests performed. We calculate the expected cumulative number of cancer screening based on monthly test completion in 2019.
3. The pandemic screening gap is the difference between the actual versus expected cumulative number of cancer screening tests performed. We express this pandemic gap in terms of an absolute number of tests and also in terms of a “number of months” of cancer screening service based upon the 2019 average monthly rate. Expressing the pandemic gap in terms of the number of (pre-pandemic) months of screening missed is similar to the “screening loss ratio” reported by Kelkar et al. (Kelkar et al., 2022)
4. The recent testing ratio is calculated as the proportion of individuals up-to-date on a specific cancer screening who had screening performed in the past year. The numerator for this ratio is the total number of screening tests performed in the measurement year. The denominator of this ratio is the number of individuals who are up-to-date on cancer screening during the measurement year. This calculation adjusted for 2021 to account for 10 months of available data. Change in the recent testing ratio over time indicates a shift in the proportion individuals who were recently vs. previously screened and can help explain discrepancies in trends for standard vs. test volume-based quality metrics.
5. To examine the use of different CRC screening methods, we determine the proportion of all CRC screening performed using each of the screening methods each month. We report monthly and cumulative test-volume metrics from January 2019 through October 2021.

3.3. Statistical analysis

We perform chi-square to test significance of difference in proportions (e.g. eCQMs, CRC screening methods, recent testing ratio). For continuous measures (e.g. pandemic screening gap) we provide 95 % confidence intervals for the estimates and perform *t*-tests to assess significance of differences. Analyses reported here were performed using SPSS 28.

3.4. Human subjects

This project was reviewed by the University of Michigan Institutional Review Board and considered to be unregulated as a quality improvement project examining only aggregated data.

4. Results

The annual eCQM cancer screening metrics and the number of patients eligible for screening from 2019 to 2021 are shown in Table 1. For breast cancer screening, there is a modest decrease in the eCQM metric from 2019 to 2020 and this remains decreased in 2021. For cervical cancer screening, there is a modest decrease in the eCQM metric from 2019 to 2020 with a return to near the 2019 level by 2021. For CRC screening, the eCQM metric is stable from 2019 to 2020 followed by a modest increase in 2021. For breast cancer, cervical cancer, and CRC across this time period there is a small increase in the number of patients

Table 1
Standard breast, cervical, and colorectal cancer screening metric adherence at 27 US Midwestern Community Health Centers from 2019 to 2021.

	2019 n(%)	2020 n(%)	2021 n(%)
Breast Cancer Screening Adherence	55.7	51.3*	51.7*
Patients eligible for breast cancer screening	48,037	49,707	50,730
Patients up-to-date on breast cancer screening	26,757	25,500	26,227
Total number of screenings performed	17,990	13,625	16,540
Cervical Cancer Screening Metric Adherence	54.1	51.8*	54.0
Patients eligible for cervical cancer screening	103,650	105,366	106,503
Patients up-to-date on cervical cancer screening	56,075	54,580	57,512
Total number of screenings performed	25,733	18,899	23,611
Colorectal Cancer Screening Metric Adherence	43.2	43.0	45.6*
Patients eligible for colorectal cancer screening	95,619	98,256	100,651
Patients up-to-date on colorectal cancer screening	41,307	42,250	45,897
Total number of screenings performed	15,497	12,055	14,207

* Chi-Square p-value for comparison to 2019 < 0.001.

eligible for these screening metrics.

The trend for the monthly number of breast, cervical, and colorectal cancer screening tests completed at health centers in our sample is shown in Fig. 1. There is a sharp decrease in the number of breast, cervical, and CRC screening tests completed per month starting in the Spring of 2020. There is a gradual recovery in the number of monthly tests completed for each type of cancer screening through the rest of this year. The horizontal lines in Fig. 1 (panels A-C) represent the 2019 monthly average number of each type of cancer screening test completed (i.e. pre-pandemic rate). The number of breast, cervical, and CRC cancer screenings performed each month in the second half of 2020 and majority of 2021 is largely below the pre-pandemic monthly average rate.

The effect of these changes on the cumulative total number of screening tests performed is shown in Fig. 2. Each panel shows the actual cumulative number of screening test performed compared to the expected cumulative number if screening had been performed at the pre-pandemic (i.e. 2019) average monthly rate. From January 2020 through October 2021, health centers performed a cumulative total of 27,408 mammograms compared to an expected cumulative total of 32,817. This represents a 16 % deficit. The actual cumulative total number of cervical cancer screening tests performed was 38,575 compared to an expected cumulative total of 47,177 tests. This represents a 18 % deficit. The actual cumulative total number of CRC screenings performed was 23,894 compared to an expected total of 28,411 tests. This represents a 16 % deficit.

Fig. 3 presents the difference between the actual and the expected cumulative number of cancer screening tests performed. This difference represents the pandemic screening gap for each cancer type. For breast, cervical, and colorectal cancer screening, the pandemic screening gap grows rapidly in the Spring and early Summer of 2020 consistent with the sharp decline in number of cancer screenings completed in these months. The size of the pandemic gap for each type of cancer screening stabilizes in the later part of 2020 but then begins to grow gradually larger again in the latter half of 2021. From January 2020 to October 2021, health centers performed approximately 5400 fewer mammograms than might have been expected based on the rate of screening in 2019. This corresponds to 3.6 months (95 % CI 3.4–3.9 months) of breast cancer screening activity based on the pre-pandemic average monthly rate. For cervical cancer screening, health centers performed approximately 8600 fewer screenings than might have been expected. This corresponds to 4.0 months (95 % CI 3.8–4.3 months) of screening activity based on the pre-pandemic monthly rate. For CRC screening, health centers performed approximately 4500 fewer screenings than might have been expected. This corresponds to 3.5 months (95 % CI 3.2–3.8 months) of screening activity based upon the pre-pandemic monthly rate. The pandemic gap for cervical cancer screening is significantly greater than the gaps for either breast cancer ($p = 0.05$) or CRC ($p = 0.01$) screenings.

From 2019 through 2021, there is a shift in use of different CRC screening methods with a decrease in the proportion of screenings done via colonoscopy and an increase in the proportion of screenings done via stool testing, particularly FIT-DNA stool testing. Specifically, in the first six months of 2019 (January–June 2019) 49.3 %, 45.8 %, and 4.8 % of CRC screenings were done via colonoscopy, FIT, and FIT-DNA testing, respectively. In the final six month of our study period (May–October 2021) 43.5 %, 42.9 %, and 13.5 % of CRC screenings were done via colonoscopy, FIT, and FIT-DNA testing, respectively (chi-square = 355.9, $p < 0.001$). In both time periods fewer than 0.2 % of CRC screenings were done with some other method (i.e. sigmoidoscopy or computed tomography colonography).

Fig. 4 presents the recent test ratio for the three cancer screenings. In 2019, 67 % of individuals up-to-date on breast cancer screening, 45 % of individuals up-to-date on cervical cancer screening, and 37 % of individuals up-to-date on CRC screening had their screening test performed during the measurement year. For all three screenings, the recent testing ratio decreased significantly from 2019 to 2020. While the recent testing ratio increased from 2020 to 2021 for all three screenings, values still remain below 2019 levels.

5. Discussion

This analysis shows substantial initial and persistent negative changes in cancer screening in our state CHC network following the start of the COVID-19 pandemic. For breast, cervical, and CRC screenings we find that the pandemic screening gap (i.e., number of screenings missed after the start of the pandemic) persists and indeed grows larger through 2020 and 2021. Despite large drops in the number of cancer screening tests performed, we observed only modest changes in standard cancer screening quality metrics. Standard metrics further suggest that some cancer screening activities returned to near normal (e.g. cervical cancer screening) or even improved slightly (e.g., CRC screening) since the start of the pandemic while test-volume based metrics reveal large and persistent deficits. Recognizing and reversing the growing gap in missed cancer screening is critical to limit excess cancer burden due to the pandemic. Studies projecting thousands of excess cancer deaths due to the pandemic often considered different scenarios that varied based upon the speed at which the pandemic screening gaps were addressed (van den Puttelaar et al., 2023; Alagoz et al., 2021; Kregting et al., 2021). In hindsight, these studies may have been overly optimistic because they did not consider situations where the pandemic cancer screening gaps continued to grow over time.

This is the first study to report on both standard quality metrics and test-volume based metrics to assess possible pandemic effects on cancer screening. The magnitude and persistence of the possible pandemic effects on cancer screening is much more evident when examining test-volume based metrics compared to standard cancer screening quality metrics. An examination of CHCs nationally did find modest declines in standard cervical and colorectal cancer screening quality measures during the first year of the pandemic (Star et al., 2023a). Our study suggests that these modest declines may not capture the full potential impact of the pandemic on cancer screenings. Our study further offers the additional caution for clinics and health systems that the return of their standard cancer screening quality metrics to pre-pandemic levels does not necessarily mean that all potential pandemic effects have been addressed.

Our examination of the trends in the recent testing ratio for cancer screenings following the start of the pandemic offers some insight into the discrepancy. In the calculation of standard quality metrics, individuals are included in the numerator if they are considered to be up-

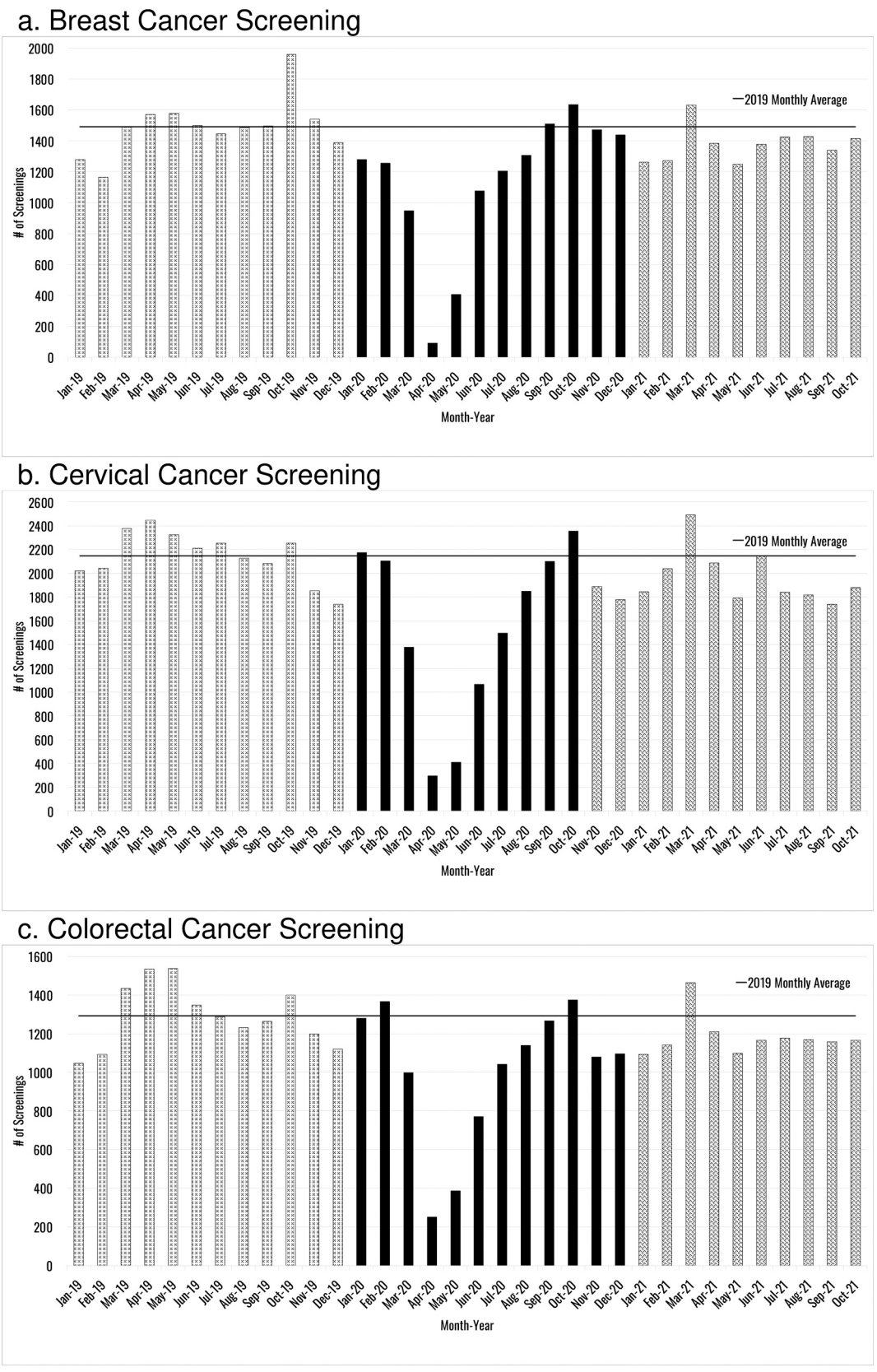

Fig. 1. Monthly cancer screening test volume at 27 US Midwestern Community Health Centers from January 2019–October 2021.

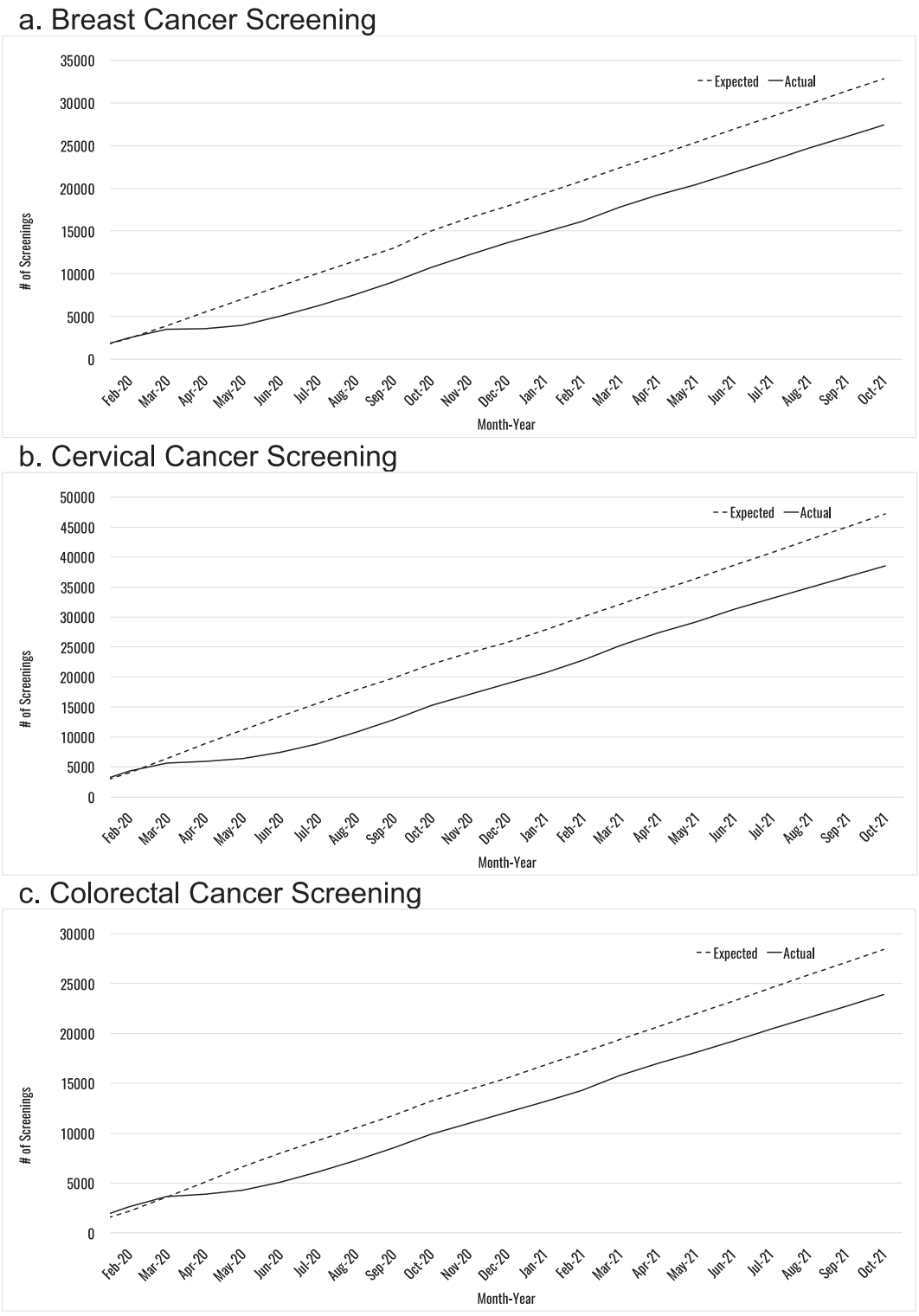

Fig. 2. Actual vs. expected cumulative number of cancer screening tests at 27 US Midwestern Community Health Centers from January 2020 – October 2021.

to-date with recommended cancer screening guidelines (i.e. had appropriate screening performed in the appropriate time interval). Given the time intervals for cancer screening, many of these up-to-date individuals were screened prior to the measurement year. While this is entirely appropriate from perspective of the individual, the inclusion of previously screened individuals can also somewhat obscure the current rate at which screening tests are being performed by an organization. We do in fact observe a decrease in the recent testing ratio for all three cancer screenings with greater proportion of up-to-date individuals being previously screened and a smaller proportion being recently screened after the start of the pandemic. This means that after the start of the pandemic, standard quality metrics became more reflective of prior rather that current screening activity and contributed to making standard metrics less sensitive to the sudden disruption in services brought on by the pandemic.

It is important to understand our findings with respect to other

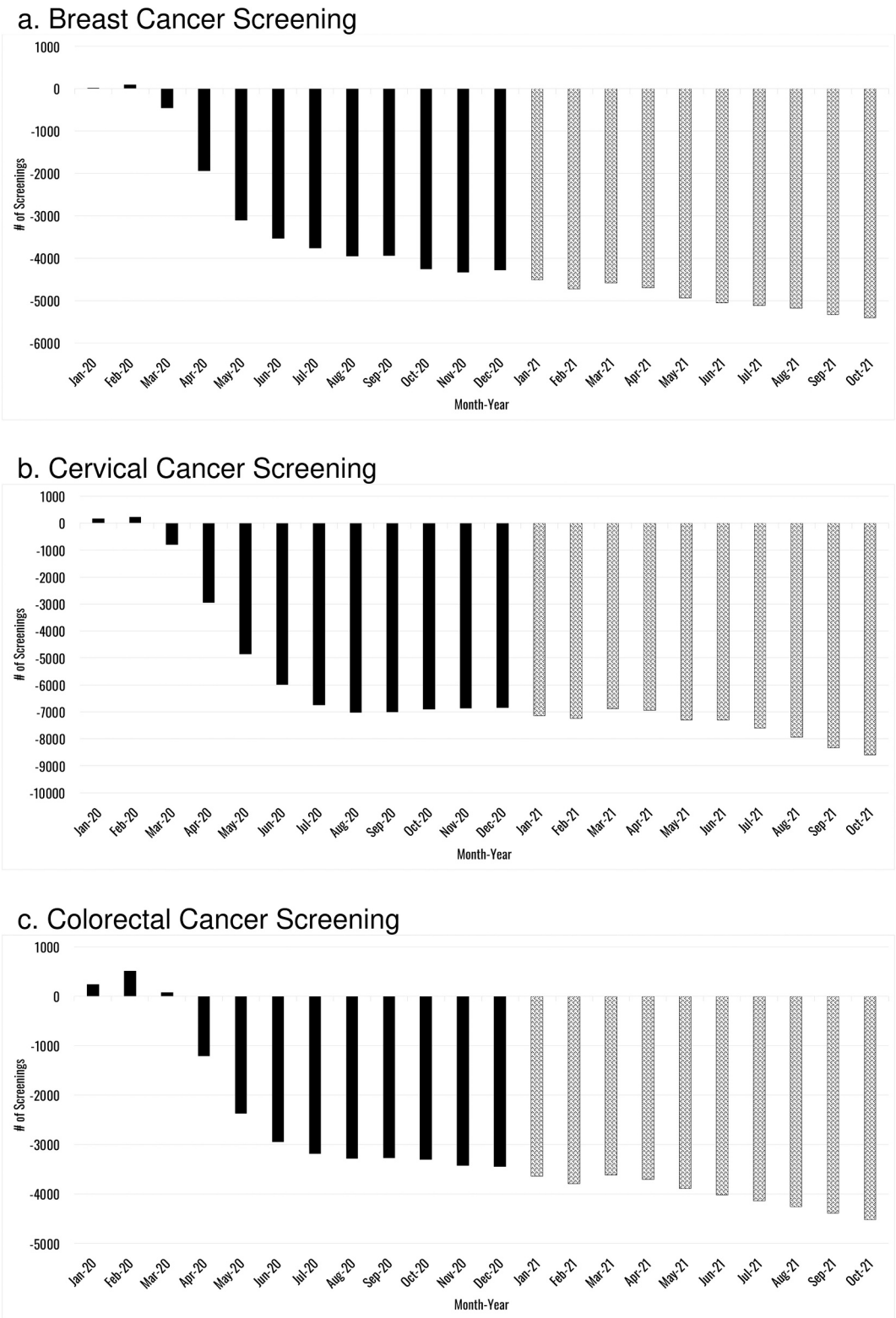

Fig. 3. Trends in the pandemic cancer screening gap at 27 US Midwestern Community Health Centers from January 2020 – October 2021.

studies that have reported on changes in cancer screening activities following the start of the pandemic. The majority of these studies focused on the changes at the very start of the pandemic and during an initial "reopening" period (e.g. the third or fourth quarters of 2020). Many of these studies showed a resumption of cancer screening services at levels that did not reach pre-pandemic baselines. This means that in these settings the pandemic screening gap would continue to grow, albeit at a slower rate, after reopening (Carroll et al., 2022; Holland et al., 2022; DeGroff et al., 2021; Bakouny et al., 2021; Choy et al., 2022; Angelini et al., 2023). For example, DeGroff et al. reported that rates of cancer screening during the reopening period among women with lower income or inadequate health insurance served by the National Breast and Cervical Cancer Early Detection program were still approximately 40 % lower than the pre-pandemic baseline (DeGroff et al., 2021). This is

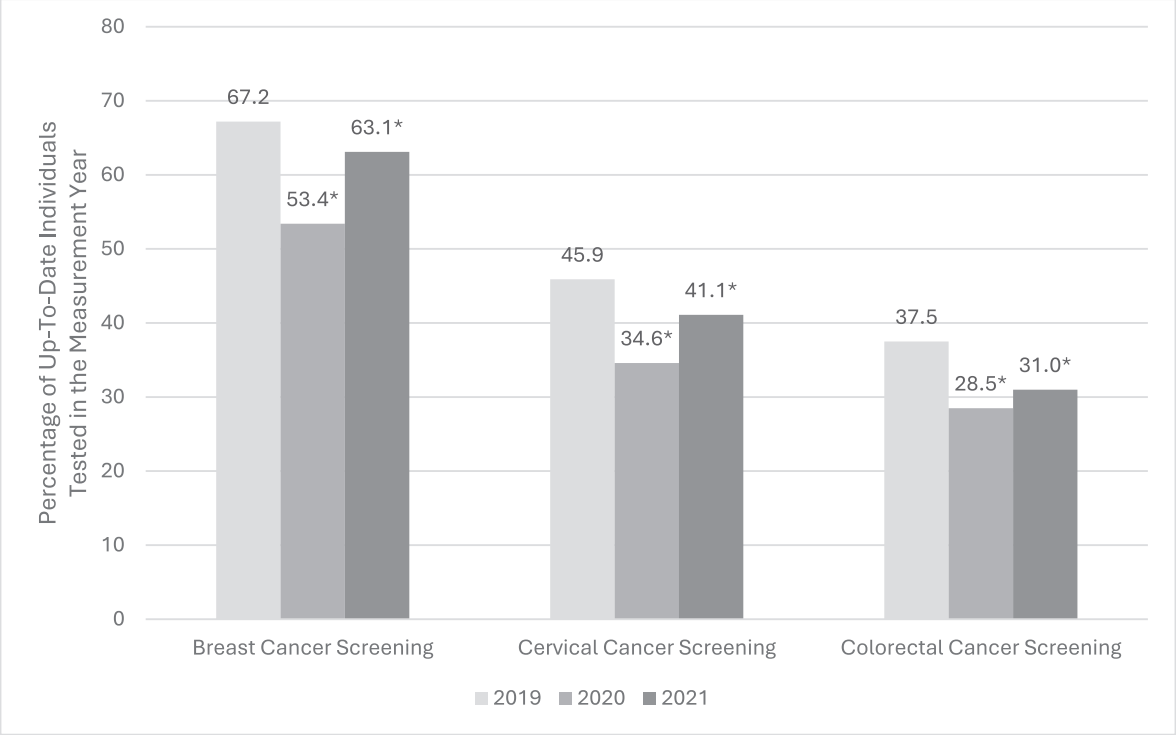

Fig. 4. Percentage of individuals up-to-date on cancer screening that completed testing in the past year at 27 US Midwestern Community Health Centers from 2019 to 2021.
* *t*-test p-value comparison to 2019 < 0.001.

consistent with the patterns we observe across our CHCs with a persistent and growing pandemic screening gap over time. Other studies have reported a resumption of cancer screening activities at rates that did largely return to pre-pandemic baseline values (Lee et al., 2022; Chen et al., 2021; Nyante et al., 2021). It is important to recognize that even in these cases the pandemic screening gap would still persist (i.e., not falling farther behind but also not catching up on missed screenings). A few studies have also reported a resumption of cancer screening services that reached levels higher than the pre-pandemic baseline (Kelkar et al., 2022; Miller et al., 2021; Labaki et al., 2021). These findings, showing an actual reduction in the cumulative pandemic screening gap, have tended to come from academic health centers or their affiliated networks.

A smaller number of studies have begun to examine the potential pandemic effects on cancer screening beyond the end of 2020. Using data from the National Health Interview Survey, Star et al. found decrements in the proportion of eligible individuals who reported past-year breast and cervical cancer screenings in 2021 compared to pre-pandemic rates (Star et al., 2023b). Analyses of national insurance claims from either multi-payer or Medicare databases are consistent in showing an initial large decline in the number of cancer screenings performed in early 2020, a rebound to or near to pre-pandemic rates in the latter half of 2020, and then a second decline in 2021 (Oakes et al., 2023; Mafi et al., 2022; Doan et al., 2023). Studies by Doan et al. and Randle et al. note a specific correlation between later declines in cancer screening and additional waves of COVID-19 infection in 2021 (Doan et al., 2023; Randle et al., 2022). While these studies did not assess or report on the cumulative pandemic gap in cancer screenings, the failure to exceed pre-pandemic screening rates coupled with second drops in cancer screening rates later in 2021strongly suggests that the cumulative screening gap would have continued to grow over this time period as we found here.

In our state CHC network during the time of this study, we found a somewhat greater pandemic screening gap for cervical cancer screening compared to breast cancer or CRC screening. Few studies have assessed or directly compared the pandemic gap for different types of cancer screening though many studies have demonstrated disparities in changes in cancer screening with more access challenged and more socially vulnerable populations experiencing greater negative effects (Miller et al., 2021; Choy et al., 2022; Randle et al., 2022; Fasano et al., 2022; Richman et al., 2023; Nwankwo Jr. et al., 2022). Our finding of a greater pandemic gap for cervical cancer screening suggests, at least in populations served by CHCs, that the pandemic may have had a greater potential effect on the engagement of younger women in cancer screening activities. Additional work is needed to determine how individual characteristics (e.g. age, gender, social determinants of health) might interact with health system factors to affect changes in cancer screening following the start of the pandemic.

Attention to test volume-based metrics such as the pandemic screening gap may also offer some guidance on how to address the potential impact of COVID-19 on cancer screening. A focus on testing volume metrics makes clear that in order to close the pandemic screening gap, health centers will have to complete cancer screenings at a higher rate than before the start of the pandemic. Simply returning to pre-pandemic screening rates would prevent the pandemic screening gap from growing but this would not allow for catch up on the number of missed cancer screenings. This principle of needing to "exceed pre-pandemic screening levels" is a core component of the national "Return to Screening" initiative (Joung et al., 2022). This is not a simple task. Richman et al. highlight the need for multimodal interventions (e.g. policy, community, health system, clinician) to address the complex multifactorial conditions that underlie health disparities (Richman et al., 2023). Several studies suggest population outreach and use of telehealth services may be important approaches to increase access to cancer screening services (Luu, 2022; Chen et al., 2021; Fisher-Borne et al., 2021).

There are several limitations to the findings we present in this study. First, the findings we present are from only one state CHC network. The

specific trends we observe and the magnitude of the differences between standard and test-volume based metrics could vary in other state health care settings. Second, the data we present is only available at the aggregate level. This means that we are not able to address issues related to health center or individual level variation. Third, due to limits on the availability of centralized standardized cancer screening data, we are not able to report on cancer screening test volume prior to 2019. While we believe the changes we observe are due to the pandemic, we are not able to assess for other possible pre-pandemic trends (prior to 2019) that might have influenced these results. Finally, we are not able to examine specific causal factors that underline patterns of change in the pandemic screening gap. Future work including detailed multilevel assessment (e.g. system, provider, and patient levels) would likely be needed to help identify these factors.

6. Conclusion

There are several important lessons to take from this work presented here. First, our findings support the importance of considering test volume-based metrics such as the pandemic screening gap in addition to standard cancer screening quality metrics in order to understand the potential impact of the COVID-19 pandemic on cancer screening. Second, by examining cancer screening test volume we see that the pandemic screening gap persisted and continued to grow in the first years of the pandemic. A focus on test volume and testing rates also makes clear that in order to meet ongoing patient needs and catch up on cancer screenings missed during the pandemic thus far, health systems will need to screen at a higher rate than before the pandemic. Finally, our work here highlights the need to better understand and address the possible persistent effects of the COVID-19 pandemic on cancer screening. While the most acute changes in the delivery of cancer screening services may have passed, we cannot assume that the pandemic no longer has a potential impact on screening or that prior potential impacts have been fully addressed. Attention and support for clinical networks that provide care for otherwise underserved populations is critical to prevent the COVID-19 pandemic from exacerbating health disparities in the burden of cancer.

CRediT authorship contribution statement

Lawrence C. An: Writing – original draft, Validation, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Amy Zarr-McDonagh:** Writing – review & editing, Validation, Methodology, Investigation, Conceptualization. **Andrew Krumm:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Elizabeth Bacon:** Writing – review & editing, Validation, Methodology, Formal analysis, Data curation. **Celeste Liebrecht:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Halli Rennaker:** Writing – review & editing, Validation, Formal analysis, Data curation. **Faiyaz Syed:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Ken Resnicow:** Writing – review & editing, Methodology, Investigation, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, none of the authors used generative AI or AI-assisted technologies in the writing process.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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